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Appraisal Of Farmers' Understanding, Perception And Knowledge Of Climate Change And Adaptation Strategies In Jema'a Local Government Area, Kaduna State, Nigeria

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Abstract
It is common knowledge that farmers in Sub-Saharan Africa, including Nigeria are struggling to cope with the current climate variability. Our response to climate change is measured in terms of adaptation. Adaptation to climate change requires that farmers first notice that the climate has changed, and then identify useful adaptation measures and implement them. This study analyzed farmers' perception and knowledge on climate change and adaptation strategies in Jema'a LGA, Kaduna State. Rainfall and temperature data (1980 – 2014) were used to characterize the climate of the study area. 382 farmers were purposively sampled and administered questionnaire. Trendlineswere used to show the pattern in rainfall and temperature of the study area. The results were presented in tables and on charts. The results showed that 93% of the farmers are aware of climate change; the farmers' perception on climate change issues in the study area are in line with the analyzed rainfall and temperature data. The results further showed that the farmers perceived early onset, early cessation; decrease in the length of growing season, increased incidences of flood after rain and continuous poor yield condition as pointers to climate change.Multiple cropping, use of early maturing crop and use of crop varieties that are well acclimatized were the major adaptation strategies the farmers use in the study area. The study recommended that the federal, state, local government and extension agents should consistently educate the farmers on how to monitor and predict climatic trends in the study area and adaptation strategies; provide farm inputs and other assistance to the farmers. Agricultural research institutions in Nigeria should develop drought resistant and early maturing seeds to boost crop production.

Key Words: *Adaptation, Climate Change, Farmers, Knowledge and Perception*

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I. Introduction

Climate Change is now widely recognized as a major environmental problem facingtheglobe. The risks associated with climatechange are real but highly uncertain (UNEP, 2013). Climate change has the potential ofaffecting all naturaland human systems and may bea threat to human development and survival socially,politically and economically (Ali, 2011).Weather and climate act both as a resource and a constraint to agricultural production. The resource value of weather has to be optimized while the hazards posed by weather have to be managed (Ayoade, 2002). All stages of agricultural production from land clearing and preparation, through crop growth and management to harvesting, storage, transportation, and marketing of agricultural products are subject to the influence of weather and climate. However, a nagging question begging for an answer is, "how much does the public and farmers know about climate change and the threat it poses?"

Perception refers to beliefs or opinions often held by many people based on how things seem to them. Knowledge, on the other hand, concerns the way people understand the world, and how they interpret and apply meaning to their experiences (Blaikie, Brown, Stocking, Tang, Dixon and Silitoe, 1997). Both perception and knowledge guide decision making and consequently, farmers' action on climate change adaptation. In an inquiry into social limitations to climate change adaptation, Adger, Dessai, Goulden, Hulme, Lorenzori, and Wrefordet. al.,(2008) argued that, in addition to limitations presented by availability of technology and the capacity for learning, other elements including perceptions and knowledge considerations within society fundamentally limits climate change adaptation. Leiserowitz (2005) also noted that public perceptions are critical components of the sociopolitical context within which policymakers operate, and can fundamentally compel or constrain political, economic, and social action to address a particular risk such as climate change.

Perception determines the social mental pictureof climate change. But a number of othervariables like socio-demographic and socio-economic factors or ideological orientations of the farmers influenceperception and the mental picture of climatechange(Stedman 2004).According to Grothmann and Patt (2005) perception is a precondition foradaptation. Previous studies (Ikpe, 2014; Kisauzi, Mangheni, Sseguya and Bashaasha, 2015) have reported that farmers have perceived changes in rainfall and temperature patterns over the years as evidence of climate change. According to Adger, Agrawal, Mirza, Conde, O'brien and Takahashi (2007), perception on climate change showed that a significant number of farmers believe that temperature has already increased and that rainfall pattern has declined for African countries leading to low yield of agricultural crops, less vegetation for livestock and water for irrigation.

Adaptation is an important component of climate change impact and vulnerability assessment, and is one of the policy options in response to climate change impacts (Fankhauser, 1996). Our response to climate change is measured in terms of adaptation. Adaptation is how we respond to (or prepare for) climate change, in order to reduce the negative impacts and take advantage of positive impacts.Indeed, the significant role of adaptation as a policy response by government has been recognized internationally. The Intergovernmental Panel on Climate Change defines adaptation as adjustments in ecological, social or economic systems in response to actual or expected climatic stimuli and their effects. This term refers to changes in processes, practices, and structures to moderate potential damages or to benefit from opportunities associated with climate change (IPCC, 2001).

Understanding the climatic nature and future climate change of an area has led to a realization that significant future impacts of climate change are inevitable and increased efforts towards understanding the process of adaptation to the threatened impacts are required (Adger, 2001).According to Herath and Ratnayake (2004), understanding climate change is essential to optimally manage the scarce farm inputs and water resources that are already stressed due to the increasing water demands, increase in population and the economic development. The knowledge of climate variability over the period of instrumental records and beyond on different temperature and spatial scale is important to understand the nature of different climate systems and their impact on the environment and the society. Peters (1998) opined that perception is importantbecause a misconception of a risk hasundesirable consequences. Misconceptions canlead to maladaptation, which increases the costsof climate change.

Farmers' interest in climate mainly regards the need to forecast weather to adjust their croppingdecisions (Roncoli, 2006). Lack of adequate knowledge and information has been reportedin previous studies as an obstacle to adaptation and thereforecalls for good quality, accurate and accessible information (Hillel and Rosenweig, 2014).Knowledge is a critical ingredient and the most important inputin the process of adaptation (Meyer, 2014). Before adaptation, knowledgeof climate change, as well as its causes and effects, is importantso as to trigger the adaptation process (Bationo and Vlek, 2014). Climate change will affect well-being in ways that are often overlooked. Awareness of these impacts encourages public engagement and effective adaptations which invariably minimizes negative effects and capitalize on possibilities for more positive changes. It is time to develop effective ways to integrate psychological research into these efforts. Thus, this study aimed at appraisal farmers' perception and knowledge on climate change and adaptation strategies in Jema'a Local Government Area (LGA), Kaduna State.

Study Area

The study was carried out in Jema'a Local Government Area of Kaduna State. Jema'a LGA has eleven wards and Kafanchan is the headquarters. The LGA lies between latitudes $9^{o}0'00''$ N and $11°0'00''$ N from the Equator and longitudes $7^{o}0'0''$ E and $8^{o}30'0''$ E of the Greenwich Meridian. It is located at the southeast part of Kaduna State as shown in Fig. 1 (Kaduna State Ministry of Agriculture, 2007). The climate of the study area is generally characterized by alternating dry and wet seasons. The rainfall usually starts in April and ends early November, while the dry season sets in mid-November and ends in March. Ginger is normally planted in March and harvested in November. Jema'a has an area of about 1,661 Km^2 and a population of 278,735 at the 2006 National Population Census. The bulk of agricultural production in the LGA is under-taken by small scale farmers most of whose labour force, management and capital originate from the household. The main crops grown in the area includes maize, millet, rice, sorghum, yam, cocoa yam and ginger (Kure, 2007).

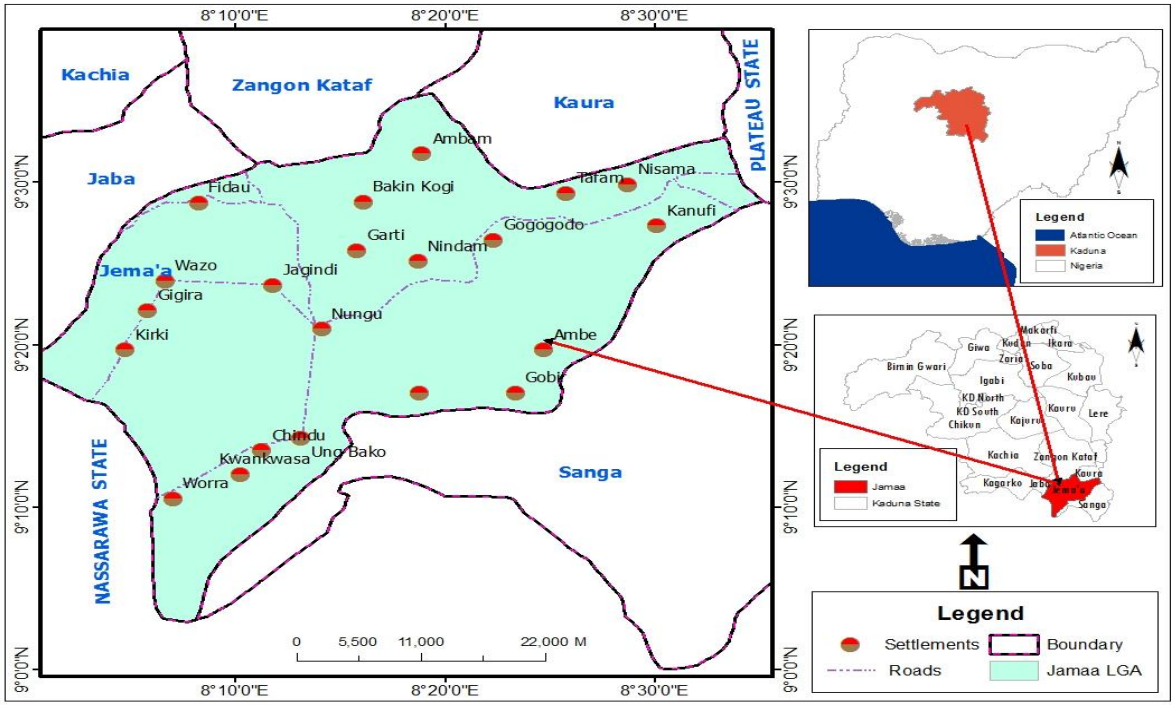

Figure 1: Jema'a Local Government Area, Kaduna State
Source: Administrative Map of Kaduna State (2020)

II. Methodology

Rainfall and temperature data for 34 years (1980 – 2014) for Kafanchan station was used to characterise the climate of the study area. Questionnaire survey was used to elicit relevant information from the sampled farmers in the eleven wards ofJema'a LGA. To determine the sample size for this research, Krejcie and Morgan's (1970) method of determining sample size was adopted which states that, for an area with a population between 75, 000 - 999, 999, the sample size to be used is 382. Since the population of the study area is 278,735 (2006 Population census) which fall between these ranges, the sample size of 382 is in order. However, 385 respondents were used to have equal representation in each ward.

Purposeful sampling technique was used to administer the questionnaire among the eleven wards of the LGA. Purposeful sampling, according to Bernard (2002) "is the deliberate choice of an informant due to the quality the informant possesses." Due to the non-availability of population figures for each ward from the 1991 and 2006 census results, the 385 questionnaireswere distributed equally among the eleven wards, with 35 questionnaires in each ward. For the purpose of administering the questionnaire, farmers above thirty (30) years of age who must have lived at least twenty (20) years within the study area were identified through the "Sarkin Noma" (Head of the Farmers) and the village Heads. This was done by asking the farmers of their ages and how long they have lived in the area. Thereafter the questionnaires were issued. The reason for this decision is that those within the age bracket have the information needed about climate change. Three hundred and seventy-two questionnaires were successfully filled and returned which was used for the analysis and discussion.

Demographic characteristics of the farmers

The results of the age of the farmers show that 33% fell within 30 – 40 years; 37% fell within 41 – 50 years; 30% fell within 51 years and above. Farmers who were above 30 years of age were purposively selected for the study which agrees with the study of Deressa, Hassan, Alemu, Yesuf and Ringler (2008), who argued that the age of the respondents represents experience on climate change. The older the respondent, the more experienced he is in knowledge of climate change and the more exposed to past and present climatic conditions over a longer horizon of his lifespan. These results imply that the sampled farmers in the study area were above the dependent age. A majority (93%) of the farmers were male, while 7% were female. This implies that agricultural activities in the study area is mainly dominated by male. The results of the marital status of the farmers shows that 87% of the sampled farmers are married. About 1% were divorced, while 10% were single and 2% were widowed.

Family labour is recognized as a major source of labour supply in smallholders crop production in most parts of Africa, including Nigeria. This comprises the labour of all males, females and children in a household, who contribute their mental and physical efforts to the household holdings. Majority of the farmers (36%) fell

within the household size of 6 - 10, followed by 19% of the farmers which fell within the household size of 11 - 15, while 11% fell within the range of 21 – 25 household size.

The results on the level of education of the farmers show that 2% of the farmers never attended a formal school, that is, they had no formal education, while about 98% of the farmers had formal education. Out of the 98% of the farmers that had formal education, about 42% of them attended primary school; 34% attended secondary school while about 22% attended higher institution at various levels. According to Enete, Madu, Mojekwu, Onyekuru, Onwubuya and Eze (2011), there is a positive and highly significant relationship between the farmers' level of education with the level of investment in indigenous and emerging climate change adaptation practices. This is to be expected as educated farmers may better understand and process information provided by different sources regarding new farm technologies, thereby increasing their allocation and technical efficiency.

The demographic characteristics of the farmers are presented in Table 1.

Table 1: Demographic Characteristics of the farmers

Variables		
Age (Years) of the Farmers	**Frequency**	**Percentage**
30 – 40	122	33
41 – 50	137	37
>51 years	113	30
Total	**372**	**100**
Gender of the Farmers		
Male	347	93
Female	25	7
Total	**372**	**100**
Marital Status of the Farmers		
Married	325	87
Divorced	04	01
Single	36	10
Widowed	07	02
Total	**372**	**100**
Household Size of the Farmers		
1 – 5	65	17
6 – 10	135	36
11 – 15	70	19
16 – 20	58	16
21 – 25	42	11
26 & above	02	0.5
Total	**372**	**100**
Engagement of Family Members in Farming Activities		
Yes	345	93
No	27	07
Total	**372**	**100**
Level of Education of the Farmers		
Primary	158	42
Secondary	126	34
Tertiary	80	22
Koranic	06	15
No formal education	02	01
Total	**372**	**100**
Religion of the Farmers		
Christianity	362	97
Muslim	08	02
Traditional religion	02	01
Others	-	-
Total	**372**	**100**
Years of Residence in the Study Area		
20 – 30	144	39
31 – 40	121	33
>41 years	107	28
Total	**372**	**100**

Source: Field Work 2018

The result of the religion of the farmers show that 97% of the farmers are Christians; 2% are Muslims, while 1% belong to the African traditional religion. The religious belief/faith of the farmers plays a major role on their perception of climate change and adaptation measures, especially on what causes climate change. According to Constable (2016), the influence of religion, especially the Christian principles was evident in her

study area (Jamaica) in the assertion that climate change is an act of God, a punishment for man's disobedience and a sign to end of the world. Tucker and Grim (2001) proposed that nature is an integral component in many religious doctrines. They stated that religion provides explanations as to how the world was created, why; what humans' role is within it and even when natural disasters occur. The result of the farmers' years of residency in the study area show that 39% of the farmers have lived in the study areas for the period of 20 – 30 years; 33% between 31 – 40 years and 29% have lived in the study area for the period of 41 years and above (Table 1).

Farmers' awareness and knowledge of climate change in the study area

Figure 2 revealed that majority (93%) representing 346 of the farmers were aware of climate change issues in the study area. This implies that farmers are sensitive to the changes going on in their environment and the level of awareness of such changes is high.

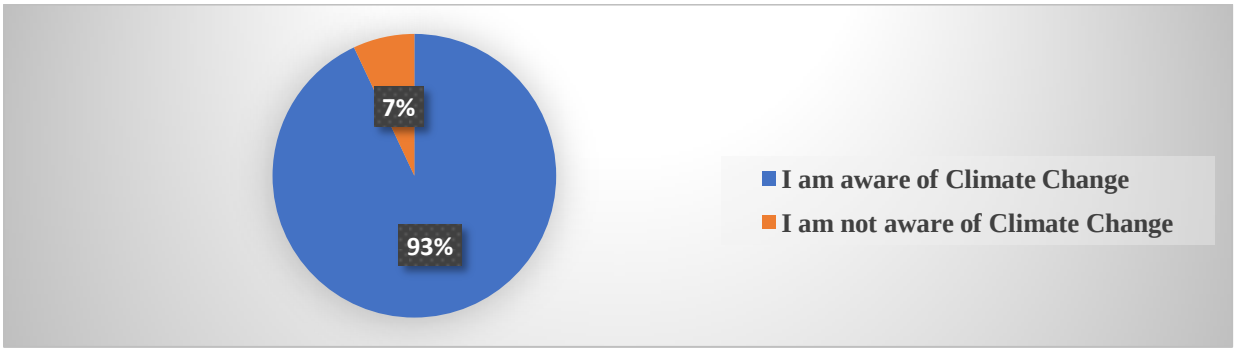

Figure 2: Farmers Awareness and Knowledge of Climate Change
Source: Field Survey, 2020

Figure 3 shows the farmers' depth of awareness of climate change in the study area. It is obvious from Figure 4 that a greater proportion (42%) of the farmers are aware and have knowledge of climate change issues to a reasonable extent; 28% have knowledge to a great extent; 26% know little about climate change while 3% stated that they only hear about climate change, but do not have details about climate change issues. By comparison, studies based on farmers' knowledge and perception of climate change issues such as Ikpe (2014) and Umar, Isah, Bello and Abubakar (2015) revealed a high level of awareness among farmers in different LGAs of Sokoto State, Nigeria.

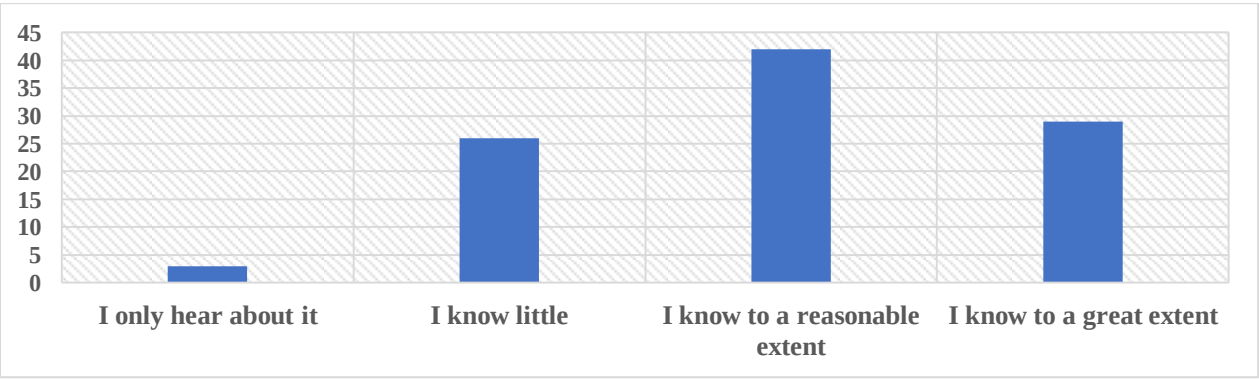

Figure 3: Farmers Level of Awareness and Knowledge of Climate Change
Source: Field Survey, 2020

Trends in Total Annual Rainfall (TAR)
The Trendin the TAR are presented in Figure 4. The TAR data for the study area was used to describe the pattern and the trend of rainfall during the period reviewed (1981 – 2014).

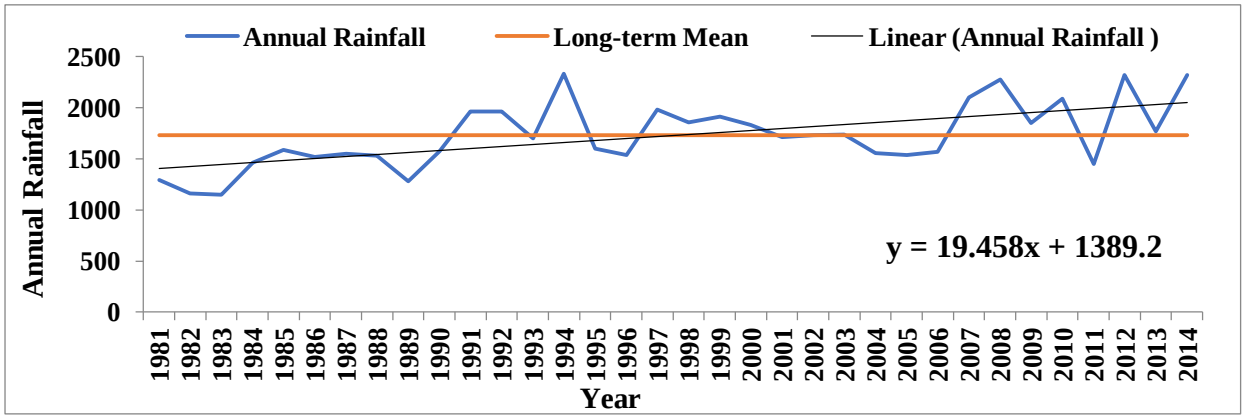

Figure 4 – Trends in Annual Rainfall for Kafanchan Station, Kaduna State (1981-2014)
***Source**: Author's Analysis for Kafanchan Station, Kaduna State (2020)*

The trend in annual rainfall series from 1981 to 2014 presented in Figure 4 shows that rainfall amount is increasing in the study area. The linear equation for the TAR (y= 19.458x + 1389.2) shows a positive trend line which signifies an above normal scenario which is favourable for crop production.This result agrees with the findings of Building Nigeria's Response to Climate Change (BNRCC, 2011) which reported that Nigeria is now experiencing wetter conditions in recent years. Omonijo (2014) in his study on rainfall amount and number of rainy days in Kaduna State reported that there are fluctuations in the amount of annual rainfall and number of rainy days which could be linked to climate change.

Trend in annual temperature

Trend in annual temperature is presented in Figure 5. To describe the pattern of temperature during the period reviewed, the minimum and maximum temperature data for the study area was used to show the trend of annual temperature within the period reviewed (1981 – 2014).

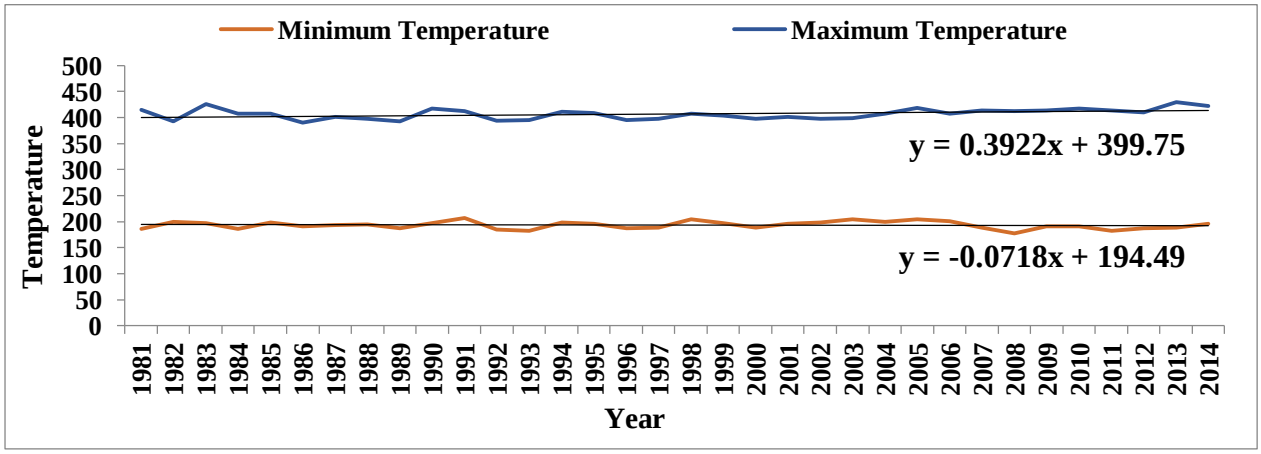

Figure 5 – Trends in Annual Temperature for Kafanchan Station (1981-2014
***Source**: Author's Analysis for Kafanchan Station, Kaduna State (2020)*

Trends in minimum and maximum temperature for the station from 1981-2014 showed a near normal data for both temperatures, although the trend line for minimum temperature was negative (y = -0.0718x + 194.49) while that of maximum waspositive (y = 0.3922x + 399.75). This implies that there is an increase in temperature of the study area within the period reviewed. Trenberth, Jones, Ambenja, Bojariu, Easterling and Zhai (2007) reported that there is a general concern that global temperatures and sea level are rising and will continue to rise throughout 21st century and that temperatures at the surface have risen globally with regional variations. Ogunrayi, Akinseye, Goldberg and Bernhofer (2016) in their study "Descriptive Analysis of Rainfall and Temperature Trends over Akure, Nigeria reported that temperature rises during the dry periods (November – March) and gradually cools at the approach of the wet season. The result is further supported by the findings of Odjugo (2010) which reported an increase by 1°C in the temperature of Nigeria between 1940 to 2010.

Farmers'perception of the climatic characteristics of the study area

The farmers' knowledge and perception of the climatic characteristics of the study area are presented in Table 2.

Table 2. Farmers Perception and Climatic Characteristics of the Study Area:

	Weather and Climate Change indices	SA	A	I	SD	D
A	The physical environment in this village is changing (desertification) due to human activities	260 (70%)	94 (25%)	-	9 (2.5%)	9 (2.5%)
B	Rainfall onset is now coming early compared to the past ten years	228 (61%)	126 (34%)	8 (2%)	6 (2%)	4 (1%)
C	Rainfall cessation is now earlier than before	185 (50%)	89 (24%)	7 (2%)	78 (21%)	13 (3%)
D	Number of rainy days/months/years is increasing	64 (17%)	82 (22%)	14 (4%)	123 (33%)	89 (24%)
E	The yearly rains are not supporting crop production as before	111 (30%)	188 (50%)	14 (4%)	44 (12%)	15 (4%)
F	Rainfall amount compared to the past ten years and more is decreasing every year	165 (44%)	145 (39%)	6 (2%)	40 (11%)	16 (4%)
G	There has been increase in temperature in recent times	189 (51%)	146 (39%)	7 (2%)	14 (4%)	16 (4%)
H	The changing climate is affecting human and animal health	178 (48%)	120 (32%)	5 (1%)	47 (13%)	22 (6%)
I	There have been increased incidences of floods during the rainy season	80 (22%)	98 (26%)	6 (2%)	103 (28%)	85 (22%)
J	Continuous poor yield condition as a result of high temperature and short growing season	186 (50%)	129 (35%)	4 (1%)	26 (7%)	29 (8%)

The farmers were asked to characterize the climate of the study area, the result shows that (70%) strongly agreed that desertification and other physical changes has been very glaring in the recent past in the study area; 25% agreed, while 2.5% and 2.5% strongly disagreed and disagreed respectively that the physical environment is changing as a result of human activities. In all, 95% (70% of strongly agreed and 25% of those who agreed) indicated that the bio-physical structure of the study areas has been affected by human activities (Table 2). This result agrees with the study of Odjugo and Ikhuoria (2003) which stated that the semi-arid region of Nigeriais characterized by desertification and unreliable rainfall for crop production.

More so, further results show that 61% of the farmers affirmed that rainfall onset is now coming early compared to the past ten years; 34% agreed; 2% were undecided; 2% strongly disagreed and 1% disagreed that rainfall onset is now coming early. On whether rainfall cessation is now earlier than before, 50% strongly agreed that rainfall cessation is now earlier; 24% agreed; 2% were indifferent, 21% strongly disagreed and 3% disagreed that rainfall cessation is now earlier. That the rain is now coming early disagrees with the study of Ikpe, Sawa and Ejeh (2018) which reported late onset dates and frequent agricultural drought in Sokoto State, Nigeria.

Seventeen percent strongly agreed that the number of rainy days is increasing in the study area, 22% agreed; 4% were indifferent, while 33% strongly disagreed and 24% disagreed that the number of rainy days is increasing in the study area. The result that the number of rainy days is decreasing in Jema'a LGA agrees with the study of Odjugo (2010) who observed that rainfall amount and duration is decreasing as rainfall amount was reduced by 178mm within the 70 years reviewed in the northwest region of Nigeria.

The farmers were asked whether the yearly rains supported crop production as before, 30% of the farmers strongly agreed that the yearly rains no longer supported crop production as before; 50% agreed; 4% were undecided; 12% strongly disagreed and 4% disagreed, stressing that the yearly rains are not supporting crop production as before. In all, about 80% of the farmers agreed that the yearly rains no longer supported crop production as before. This result agrees with the study of Odjugo (2010) which observed that the rainfall amount in the northwest zone of Nigeria is decreasing with an increasing temperature which has eventually shortened the growing season of crops and has forced the farmers to shift from the cultivation of sorghum as their best crop to millet which has a shorter growing season of 2 – 3 months.

On whether temperature is increasing in the study area, 51% strongly agreed, 39% agreed, 2% were indifferent; 4% strongly disagreed and 4% disagreed.The result of these findings shows that majority of the respondents perceived higher temperature for at least 10 years agrees with the finding of Kassahun (2009) who noted that majority of the respondents for his study perceived that there is an increase in the mean temperature for at least two decades.

On whether the changing climate is affecting human and animal health, 48% of the farmers strongly agreed that human and animal health has been affected, 32% agreed, 1% were undecided, 13% strongly disagreed, while 6% disagreed that the changing climate affect human and animal health. On the increased incidences of floods after rainfall, 22% strongly agreed; 26% agreed, 2% were undecided, 28% strongly

disagreed and 22% disagreed on the increased incidence of floods after rain in recent times. Concerning the continuous poor yield condition as a result of high temperature and short growing season, 50% strongly agreed that there has been a continuous poor yield as a result of high temperature and short growing season; 35% agreed; 1% were undecided, 7% strongly disagreed and 8% disagreed that climate change is negatively affecting crop yield (Table2).

Farmers' indigenous and emerging strategies to climate change adaptation

According to IPCC (2007), adaptation has three possible objectives: to reduce exposure to the risk of damage; to develop the capacity to cope with unavoidable damages; and to take advantage of new opportunities. The climate change adaptation strategies used by the farmers in the study area are presented in Table 3.

Table 3: Climate Change Adaptation Strategies

S/N	Adaptation Strategies	Always	Rarely	Not at all	$\bar{\chi}$	Rank
1	Early and late planting	300	61	11	2.7*	4
2	Use of organic manure	251	77	44	2.5*	10
3	Use of inorganic fertilizer	267	71	34	2.6*	7
4	Planting pest and disease resistant crop	261	84	27	2.6*	7
5	Use of crop varieties that are well acclimatized	299	66	07	2.9*	1
6	Planting of cover crops	276	76	20	2.6*	7
7	Use of irrigation system/water storage	61	85	226	1.6	18
8	Reforestation/Afforestation	09	34	329	1.2	19
9	Use of chemicals like herbicide, insecticide	176	98	98	2.2	11
10	Increase in number of weeding	168	128	76	2.2	11
11	Use of early maturing crop varieties	331	39	02	2.9*	1
12	Preservation of seeds/seedlings for planting	293	60	19	2.7*	4
13	Use of weather-resistant variety	288	76	08	2.7*	4
14	Mixed farming practices	137	141	94	2.1	12
15	Use of recommended planting distance	87	57	288	1.6	17
16	Changing the timing of land preparation	130	141	101	2.1	12
17	Changing harvesting dates	109	123	140	1.9	16
18	Loans, grants and subsidies	120	150	102	2.0	15
19	Multiple cropping	363	08	01	2.9*	1

Source: Field Survey, 2020

***Significant Adaptation Strategies ($\bar{\chi} \geq 2.5$)**

Table 3presented a summarized 19 indigenous and emerging strategies for climate change adaptation used by farmers in Jema'a LGA. Respondents' responses to questionson Likert scale for frequency level (3 = Always, 2= Rarely and 1= Not at all) were analyzedusing mean distribution. This result revealed that out of the 19adaptive strategies, 7 were "highly adopted" by the farmers as reflected in their mean score values of ≥2.5. The most significant adaptation strategies to climate change used by the farmers in the study area are multiple cropping, use of early maturing crop varieties and use of crop varieties that are well acclimatized (ranked 1st) with a mean score ($\bar{\chi}$ =2.9). Next in rank are early and late planting, use of weather- resistant variety and preservation of seeds/seedlings for planting (ranked 4th) with a mean score ($\bar{\chi}$ = 2.7). The remaining 11 strategies were "adequately adopted" given mean score values from 1.5 to 2.49. It is however noteworthy that none of these strategies was poorly adopted". These findings corroborated (Ogunleye and Yekini, 2012) who concluded that the widely adopted adaptation measures of climate in the Niger Delta region were planting of cover crops like melon to help conserve soil moisture.

III. Conclusion

Through the careful appraisal of farmers' perception and knowledge on climate change (rainfall and temperature) at Jema'a LGA of Kaduna State, the study finds an increasing trend in both the climatic variables. The major findings can be concluded as below;

1. 93% of the sampled famers are aware of climate change issues in the study area
2. 42% of the farmers know about climate change to a reasonable extent
3. Trends in annual rainfall show an increasing rainfall amount (y= 19.458x + 1389.2)
4. Jema'a LGA exhibit increasing trends in maximum annual temperatures with the trend line equation given as y = 0.3922x + 399.75
5. 61% of the respondents strongly agreed that rainfall onset is now early compared to the past ten years
6. 50% of the farmers strongly agreed and 24% agreed that rainfall cessation dates are now earlier than before
7. 50% strongly agreed and 35% agreed that there has been continuous poor yield in crop production as a

result of high temperature and short growing season

8. Multiple cropping, use of organic and inorganic manure and the use of improved seed varieties are the main adaptation strategies among others the farmers are using in the study area.

IV. Recommendations

Based on the findings of the study, it is therefore recommended that the extension agents need to consistently educate and inform the farmers on other viable ways of adapting to climate change in the study area. More so, since the use of improved seed varieties is a major adaptation strategy, the Cereal Research Institutes should develop more drought resistant seeds and early maturing varieties for the farmers in the study area. The federal, state, local government and extension agents should consistently educate the farmers on how to minitor and predict climatic trends in the study area and adaptation strategies, provide farm inputs and other assistance to the farmers. Agricultural research institutions in Nigeria should develop drought resistant and early maturing seeds.

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